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STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

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December 5, 1994

Mr. Dean Fowler
Spokane County Utilities
West 1026 Broadway
Spokane, WA 99260

Dear ~~Mr. Fowler:~~ DEAN

Re: Comments on Draft Aquifer Management, Quality Assurance, and Field Sampling Plans, and Computer Simulation

The Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) have completed there review of the draft Aquifer Management Plan, Quality Assurance Project Plan, and Field Sampling Plan. Ecology's comments supersede all comments on the Management plan in our November 18, 1994, letter to you as these comments are more comprehensive.

Although the plans are well written and thorough, we have identified four general areas of concern that are identified in the general comments below. Potential consequences from the areas of concern include relocation of all downgradient monitoring wells, construction of some new extraction wells, invalidation of the computer simulation, and invalidation of the County's current compliance groundwater monitoring. These potential consequences also include risk to human health.

Currently, the County is undertaking compliance groundwater monitoring of the extraction system. Neither Ecology or the EPA have reviewed the undertaking, nor have we received any monitoring data. We broached the subject of compliance monitoring in an April 7, 1994, letter to the County. We do not believe the County has taken the initiative in regard to working out a compliance monitoring program with us.

Given the potential, expensive and human health consequences outlined above, we would want a written response to each comment, and an answer to all questions in the comments by January 31, 1995. Any question or comment that could not be addressed by that time should be identified to Ecology and the EPA in writing by January 10, 1995, along with the reason why the comment can not be addressed in the allotted time frame. We encourage verbal communication in this matter.

If you have any questions regarding this letter please contact Michael Kuntz at (206)407-7239, or Neil Thompson at (206)553-7177. Thank you for the draft Aquifer Management Plan, Field Sampling Plan and Quality Assurance Project Plan.

Sincerely,

Michael Kuntz
Managing Hydrogeologist
Department of Ecology

Sincerely,

Neil Thompson
Project Manager
US EPA

MK:NT:gj
Enclosure

ECOLOGY AND EPA COMMENTS ON
DRAFT AQUIFER MANAGEMENT, QUALITY ASSURANCE,
FIELD SAMPLING PLANS AND COMPUTER SIMULATION

GENERAL COMMENTS

1. Comparing measured drawdowns to computer simulated drawdowns for the purposes of monitoring and evaluating the groundwater extraction system is not acceptable at this time. Thus, the current monitoring "program" is not acceptable. We believe the current program may present a potential risk to human health.

2. The computer simulation of the upper and lower aquifer is invalid for compliance monitoring purposes due to inadequate calibration data, unsubstantiated assumptions and because model boundaries, critical assumptions, and calculation for numerous input parameters can not be verified.

3. As reported, the location of three of the south system monitoring wells and two of the east west system monitoring wells do not satisfy Consent Decree requirements. Due to inaccuracy in the computer simulation, and other factors, there is high probability that all the other monitoring wells do not meet Consent Decree requirements for monitoring well location. This presents a risk to human health.

4. Contaminated groundwater appears to be migrating unchecked to the east and northeast of the landfill in the lower aquifer. As simulated by computer, the East\ West extraction appears to allow breakthrough of contamination. The South system monitoring wells do not provide adequate coverage. These conditions presents a risk to human health.

SPECIFIC COMMENTS

AQUIFER MANAGEMENT PLAN

1. Although the MODFLOW and PATH3D simulations were a tool for siting monitoring wells, those simulations, in their present form, are not suitable for evaluating compliance for ground water monitoring, and ground water remediation, as indicated in following comments.

   In regard to compliance for groundwater monitoring and groundwater monitoring, the County would have two options: 1) bring the data base up to scientific standards, confirm and validate the input parameters and re-run the model with updated data, or 2) propose an alternate means of evaluating compliance for groundwater monitoring and groundwater remediation.

2. As depicted in figure 7-4 of the management plan, a portion of the groundwater plume in the lower aquifer is migrating to the east and northeast of the landfill. This migration route runs counter to groundwater flow direction depicted in Figure 7-2. In attempting to compare figure 7-4 to 7-2, (groundwater flow), and to figure 7-7 (groundwater capture), we conclude that the contamination is not being captured. We do not believe the extraction system will capture the plume. Also, it appears as if this contamination is in a different geologic formation than the formation containing the extraction wells. Structural geology or domestic water use may be factors in this migration.

   When was the last time groundwater was analyzed to track this plume? What is the County's opinion as to the reason for migration of this plume? How far is this plume expected to migrate? What steps will the County take to mitigate this plume and what is the schedule for these steps?

3. As reported in figures 7-5 and 7-6, the location of south system monitoring wells CD-31, CD-34 and CP-S3 are within the capture zone, and therefore do not meet Consent Decree requirements for the location of compliance monitoring wells. Consent Decree requirements for the location of south system monitoring wells are identified on page V-1 of the Decree.

   The Decree requires that monitoring wells are to be located downgradient of the capture system (i.e., outside the capture system). This location provides for a determination of water quality entering the clean portion of the aquifer, and also provides a measure of protection for downgradient receptors that may be exposed to contaminants of concern that get through the system. Wells CD-31, CD-34 and CP-S3 monitor groundwater that is captured, treated, and discharged to the Little Spokane River. Monitoring wells in the capture system do not provide a measure of protection for downgradient receptors, and will not count as downgradient monitoring wells.

   What is the County's assessment on the location of these monitoring wells in the capture zone? In making the assessment please provide all calculations, and assumptions. If these requests are not satisfied we will move to have the wells replaced with true downgradient wells due to concern over public health.

4. Using figures 7-5 and 7-7, the location of east\west system monitoring wells CD-445 and CD-45 are located in the capture

zone, and therefore do not meet consent decree requirements. These wells do not monitor aquifer return water, but water that is discharged to the Little Spokane River. The monitoring requirements for the location of the west system monitoring wells are identified on page V-13 of the Decree. The health issue and compliance conditions of the above comment apply here.

What is the County's assessment on the location of these wells in the capture zone? In making the assessment please provide all calculations and assumptions. The replacement condition of the above comment applies here.

5. We also conclude, based on enclosed comments, that all the other south system monitoring wells are probably in the capture zone, and that the monitoring wells of the east/west system have a very high probability of being in the capture zone. Consequently, none of these monitoring wells meet Consent Decree requirements for location because of:

   A. the wells are either located in the capture system or are in very close proximity to the boundary of the capture system;
   B. the margin of error in the computer simulation would include the wells in the capture system; and,
   C. a perceived absence of reported or identified concern over locating the monitoring wells within the capture system.

   What is the County's assessment of the location of these wells in relation to the capture systems? In making the assessment please delineate an upper limit and lower limit to the capture systems shown on Figure 7-6 and 7-7. Base the limits on an error analysis of the computer simulation, and any other technique, or information used in depicting the capture zones. Also, please note in the record where the County indicated concern over placement of the wells in the capture zones, or took measures to see that wells were not completed in capture zones. If the requests in this paragraph are not satisfied we will consider all wells to be within the capture zones, and will move to have all wells replaced with true downgradient wells due to concern over human health.

6. The reported groundwater data must serve to answer two fundamental questions:

A. What impact does the extraction system have on the amount and availability of local groundwater supplies; and,
B. How efficiently are the extraction systems capturing the contaminant plumes?

The Aquifer Management Plan should address these two questions by describing the "hands on" methodology used by the County to collect, synthesize, manage, evaluate and report the data. Specific references to methodology in other approved plans or the Consent Decree is acceptable. The frequency and the depth and intensity of reporting should be described. We suggest a section in the plan be devoted to each of these questions. **It may be worthwhile to consider a data management plan.**

7. Regarding question B the Consent Decree defines baseline concentration, operational control criteria, evaluation criteria and adjustment control criteria, but the Decree does not state how these concepts are managed and reported. How will the County manage and report these concepts?

8. Regarding the list of compliance monitoring wells in table 7-5, wells CD 45 C1,C2, C3 and CD 48, C1, C2, and C3, are proposed to be utilized as both downgradient and cross gradient wells. This is not acceptable because downgradient and cross gradient are distinctly different phenomenon. In summary, the dual purpose of the above wells to serve as both downgradient and cross gradient wells is not acceptable.

   Our position is that new wells will have to be installed to meet the requirements. What is the County's position regarding using wells as both downgradient and crossgradient? What is your proposal for resolving this matter? In the absence of a reasonable proposal we will move to have new wells installed to meet the requirements.

9. In figure 7-1, the solid contours near the landfill indicate groundwater flow that is directed toward the bluff face over looking the Little Spokane River. The solid contours indicate flow to the River. The dashed contorts, many of which rely on a single domestic well for control, indicate the flow does not enter the river but bends away and flows parallel to the bluff face and the river. Our review of cross sectional data and permeability map data does not provide a reason the change in flow direction represented by the dashed contours.

What is your hydrogeologic reasoning for flow from the landfill heading toward the bluff face, and then bending away from the bluff face to flow parallel to the bluff face? Given the information in the above comment, why could there not be a great amount of contamination leaving the landfill and flowing directly into the river?

10. The methodology for the determination of the baseline groundwater quality concentrations determined for downgradient compliance monitoring wells from the first two years of groundwater quality data is not identified or developed. The Consent Decree describes only the frequency of monitoring for baseline determination. What methodology is proposed? (i.e., averaging all the values, or taking the highest value, etc.)

11. Regarding Figure 7-2, showing lower groundwater contours we can not determine the control used to construct the contours. Figure 7-2 contains five types of wells and many of them were constructed after the winter of 1990 when the data for the contorts was collected. The figure is unacceptable. Please provide for the management plan a groundwater contour map of the lower aquifer showing only the wells that were used to construct the map. This request is not inconsistent with standard procedures for reporting ground water contours.

12. Regarding Figure 7-3, We can not determine the control used to construct the extent of contamination. Four types of wells are noted on the figure and there are no dates for groundwater analysis on the figure. The figure is unacceptable. Please provide for the management plan a figure showing only the wells used for constructing the extent of contamination, the dates the samples were taken, and the level of contamination reported. This request is not inconsistent with standard procedures for reporting the extent of contamination.

13. Regarding figure 7-4, the issues and conditions of the above comment apply.

14. Regarding both figures 7-3 and 7-4, the period for which the data was gathered is not identified. If the period for data gathering exceeds six months, the data would very likely be influenced by seasonal variation in groundwater. Standard operating procedures for contaminant distribution maps usually require the data be gathered within a six month period or less. What is the period for gathering the data which is plotted on figures 7-3 and 7-4? Are seasonal

variations in groundwater quality factored into figures 7-3 and 7-4?

15. Regarding figure 7-3, consider dividing it into northern central and southern regions with the two dividing lines between the regions being: 1) Woolard Rd- Norwood Road, and 2) a line parallel to the first dividing line, and located 1000 feet south of Big Meadows Road.

    In this example the southern region would appear to contain over thirty monitoring points for the constituents of concern. The central region has about six points, and the northern region has three but there proximity renders them monitoring a very small area.

    Given the above, the distribution of monitoring points biases the data so that more contamination would be expected to be found in the southern area.

    What is the County's opinion on the distribution and number of data points biasing the measured distribution of contamination? What is the justification of having so many monitoring points away from the source, and so few near the source?

16. The text reference to Figures 7-8 and 7-9 does not provide a pumping rate or any parameters or assumptions regarding drawdown. Please provide the rate, parameters and assumptions. Why do these estimated drawdowns provide a reasonable approximation of anticipated values?

17. In Section 7.4.2. of the plan, the 2 year and 2 month stabilization time are not acceptable due to the comments made on computer simulation.

18. Given the amount, complexity and long-term nature of data requirements, the reported data must be in a format that allows computer manipulation and analysis. Ecology outlined this position in a June 14, 1994, letter to the County and included a computerized reporting format. Subsequent verbal communication from the County indicated the format would be followed when groundwater monitoring data is reported. Acceptable reporting of monitoring data must be in this format and should be included in the Aquifer Management Plan.

19. Regarding Section 7.3.2. the decision to modify or adjust operation of Remedial Action is not to be made by the Spokane County project manager. This decision resides with

Ecology and the EPA. Please edit the text to reflect that the decision resides with Ecology and EPA.

20. Quarterly monitoring for water level measurement to evaluate regional impact of the extraction system is acceptable on the condition that we (the governments) approve the extent of monitoring. The extent of monitoring is not defined in the plan.

21. Monthly monitoring for drawdown in extraction and monitoring wells is reasonable but comparing it to model predicted drawdowns to estimate the efficiency of capture or to evaluate the need for adjusting the system is not reasonable.

22. Regarding section 7.4.2 of the management plan what is the technical rationale, and the assumptions for the 40% and 20% adjustment criteria? What is technical rationale and assumptions for the 120 day-0.1 ft., 60 day- 0.1 ft. and 30 day- 0.1 ft. criteria?

23. Page 7-3, Section 7.2. All of the source control extraction wells are extracting from the Lower Sand/Gravel Aquifer Unit. Does there need to be source controls in the Upper Sand/Gravel Aquifer Unit (has it all migrated to the lower aquifer?)?

24. Page 7-5, Section 7.3.1. The Evaluation Criteria were established because of specific analytical limitations. Practical Quantification Limits (PQLs) were established for methylene chloride and tetrachloroethylene (PCE) in the consent decree and presented in Table 7-3. However the Scope of Work attached to the consent decree states (page IV-3, 2nd paragraph) that "If the levels to which these compounds can be accurately quantified (using EPA method 8010) change during the course of this project, Table IV-1 [Table 7-3 in the above Aquifer Management Plan] will be adjusted accordingly." The accepted PQL for methylene chloride is currently 10 µg/l (ppb), therefore the Evaluation Criteria, Table 7-3, for methylene should be changed to reflect this.

25. Page 7-8, Section 7.4.2. It appears that all of the operational adjustments are focused on the target drawdowns that were calculated from the model. There must be other operational controls that are important to manage to optimize the system.

26. Page 7-10, Section 7.5; and Figures 7-3,7-5, and 7-8. The selection of monitoring wells for the Upper Sand/Gravel

Aquifer do not appear to adequately monitor contaminant migration in the upper unit. Figure 7-5 illustrates the well locations. No wells are monitoring potential contaminant migration to the southwest, west of U.S. Highway 2 (see Figure 7-3). Private wells are generally not sufficient due to limited access and incomplete/inadequate well construction information and standards. The wells located near the extraction wells (see Figure 7-3) are all within the cone of depression depicted on Figure 7-8 and cannot monitor site contaminants that may be migrating past the capture zone on the east or west sides of the cone.

27. Page 7-10, Section 7.5.1, suggests the use of indicator compounds for monitoring the ground water. This practice is acceptable provided the correct indicators are selected and periodically a full analysis is done. The indicator compounds selected (4) do not include methylene chloride which is a major contaminant of the Lower Sand/Gravel Aquifer and was also a significant factor in the establishing the design parameters for the treatment facility. Monthly instead of annual data on the methylene chloride concentrations would seem to make sense not only as an indicator compound but also as an operational parameter.

APPENDIX E, FIELD SAMPLING PLANS

1. Page E-3, Section 3.0. The location of each monitoring well in Table E-2 only addresses a single point in the aquifer. What about the vertical profile in the thick Lower Sand/Gravel Aquifer?

2. Page E-6, Section 4.1.5, last paragraph. The Chain-of-Custody Record should be in <u>triplicate</u> instead of duplicate if you require 3 file copies; i.e., analytical laboratory, project file, and QA Coordinator.

3. Page E-10, Section 4.2.3, first paragraph, second sentence. It stated that a non-dedicated bailer or pump will decontaminated with several washes "following use." The decontamination needs to occur <u>before</u> use and rinsed after use. The decontamination procedures then need to be done again before that piece of equipment is used again for sampling.

COMPUTER SIMULATION COMMENTS

1. Regarding the data base for computer modeling, the data base for the upper aquifer appears to be a single set of water levels collected from March 28, 1990 through April 12, 1990. The data base for the lower aquifer appears to be a single set of water levels collected from January 21, 1990 through January 17, 1990. There are two critical problems with this data base:

   A. Regarding upper aquifer water levels, it is standard operating procedure in hydrogeological investigations of unconfined aquifers to collect water levels for contouring purposes within a period of 48 hours or less. This window of measurement serves to eliminate time dependant variability due to precipitation, percolation and potential barometric effects.

   Water levels in the upper aquifer were collected over a period of two weeks. We do not believe that time dependant variability is addressed in this collection, and, therefore, contend that water table contours generated from this data are invalid. Consequently, the calibration of the computer model is inadequate.

   A valid water table contour map for calibration purposes would be comprised of water levels collected within a two day period with a notation of precipitation that has occurred two days prior to, and during the period of measurement. We suggest that to determine a valid water table contour map for simulation purposes that the County follow this procedure twice over a period of one year, once during the low water levels and once during the high water levels.

   If the County wishes to contend that the water table contours are valid please reference instances, other then the Colbert project, where regulating authorities charged with protecting groundwater have accepted as valid unconfined water table contours of a contaminated aquifer generated from data collected over a two week period.

   B. Regarding hydrogeological investigations, it is standard operating procedure to estimate/quantify groundwater flow with at least two measurement events taken in one year, during a period of high water level

and a period of low water level, and that some comparison be made to water levels in other years.

The data base for calibrating aquifer simulation consists of a "snapshot" of water levels taken during a short period during 1990. It is very possible that the relationship of water levels in the measured wells varies with the seasons and thus the flow direction would change with the seasons. Perhaps 1990 was a "freak" year for water levels. We do not believe a single "snapshot" of water level measurements constitutes a valid data base for either representing the flow pattern or computer simulation of the flow pattern.

A valid data base for computer simulation would consist of several measurements taken on a seasonal basis. We suggest the County either do this or show by means of a hydrograph for several wells that the "snapshot" is representative.

If the County wishes to contend that the water table contours are valid please reference instances, other then the Colbert Project, where regulating authorities charge with protecting groundwater have accepted as valid unconfined water table contours of contaminate aquifers generated from data collected over a two week period.

2. An assumption critical to the simulation is that the Lacusterine Aquitard extends beneath the river and thus controls river conductance. However, it is reasonable to assume that the aquitard might not be beneath the river or that the River eroded the aquitard. We believe this to be a critical unsubstantiated assumption and would require geologic evidence to support the assumption (i.e., borehole geology) if computer simulation were used for compliance purposes.

   If the County is in disagreement please either provide a computer simulation of the lower and upper aquifer in which the Aquitard is absent, or a technical discussion on why the absence of the aquitard would not significantly impact the present computer simulation.

3. The upper aquifer and lower aquifer are hydraulically connected because contamination in the upper aquifer has flowed into the lower aquifer. MODFLOW has the ability to model both aquifers in a single simulation. For the investigation two simulations were used, one for the upper

aquifer and one for the lower aquifer. In effect the aquifers were modeled separately. We believe that modeling both aquifers together would provide a more accurate representation. Section 4.0 of the Final Extraction Well Plan provides no explanation on why the aquifers were not modeled together. What is the rationale for not modeling the aquifers together? What is the assessment on decreased accuracy in simulation due to not modeling the aquifers together?

4. Regarding model boundary conditions, we do not find a satisfactory explanation for the model's eastern boundary in the vicinity of the landfill. We refer to the boundary explanation in section 4.2.1. of the final extraction well plan. As drawn in figure B-4 of the plan, the upper aquifer is terminated within the confines of the landfill, and does not exist to the south east of the landfill. However, cross sections of the upper aquifer in figures ER 4-4 and ER 4-5 of the plan show that the upper aquifer extends for a considerable distance east of the landfill. In Section 4.1 it is stated that drawdown does extend to some model boundaries but the impact is minimal. Please provide the technical basis for the assessment of minimal impact of the eastern boundary on drawdown, and include the drawdown. Please identify where drawdown has extended to other boundaries and include the drawdowns.

5. Regarding upper aquifer modeling, we do not find in Section 4.3.1 of the Final Extraction Well Plan an accounting of the impact of Deep Creek in the southern boundary conditions. Deep creek's impact can be significant because of it's proximity to the extraction well field. Regarding upper aquifer modeling, a general head boundary was used to simulate the model's southern boundary. How does the general head boundary take into consideration the impact of Deep Creek on the upper aquifer? What is the impact of Deep Creek on the head in the upper aquifer in the vicinity of the Southern boundary of the computer model?

6. Regarding the western boundary of the upper aquifer, there would be flow out of the aquifer (bluff face) simply because there is nothing to stop flow and there is no structural feature to deter flow. Why then, was the western boundary modeled as a no flow boundary?

7. MODFLOW has several options for boundary conditions. For all boundary conditions selected for modeling the lower and upper aquifer we would like to see the rationale for selection in terms of boundaries rejected. What is the rationale for selecting the boundaries?

8. The modeled groundwater contours and the measured groundwater contours are represented on different figures separated by several pages of text, making it all but impossible to meaningfully compare the two sets of contours. In many reports the two sets are superimposed. We would like to see the measured groundwater contours for each aquifer superimposed on the modeled groundwater contours for each aquifer. The measured contours are already plotted in figures B-2, B-3 of the Final Extraction Well Report. The modeled contours are also plotted as Figures B-15 and 16 of the report. All that is needed is to superimpose Figure B-2 on Figure B-15 and to superimpose figure B-3 on Figure B-16. Please superimpose the figures.

9. We are concerned about contamination breaking through the east\west extraction systems. In the County's technical memorandum for modifications to the extraction system (October 1993), Section 4.2.2 states that four computer simulations using MODFLOW and PATH3D were used to model the west/east extraction systems with the elimination of extraction wells CP-W4 and CP-E4. The section concludes that capture can be accomplished without CP-W4 and CP-E4, and refers the reader to the Figures 9 through 12. However, figures 9 through 12 all show a particle path that passes through the west/east system and proceeds to the Little Spokane River. In essence, the model results do not appear to show capture. Please respond to our observation that Figures 9 through 12 show contamination breaking through the extraction well system. What is the flux and concentration of the particle path that breaks through the extraction well system? There are also particles beyond the southern boundary of the capture system. What is the flux and concentration of these particle break throughs?

10. Dispersion must be accounted for. The simulation should at least account for transverse dispersion to identify the width of the contaminant plume for determining monitoring well locations. Why would transverse dispersion not be a factor in plume width? Why was transverse dispersion not accounted for in the simulation? Design concentrations for the treatment system should not impact this issue because design data can be obtained from analytical data, and therefore would not require computer modeling.

11. We are unable to confirm or validate critical input parameters because their development/derivation is not identified or referenced. These parameters include:

    A. vertical permeability of the upper aquifer estimated to be 4E-4 ft/day;

B. leakage from the aquitard into the lower aquifer estimated to be 0.14 to 10 ft cubed/day;
C. the K values of 530 and 410 ft per day and the K values of 640 to 500 ft/day;
D. K values of 200 and 270 ft/day and K values of 1110 to 180 ft/day;
E. the delineation of the zones of high and low K;
F. the K value of 0.7 ft/day and the conductance of 150 to 1500 day E-1;
G. However, transient runs were calibrated for the Upper Aquifer Model and a satisfactory match between model-predicted and observed drawdown at the (b)(6) well was achieved;
H. The average K, average gradient and the area for the groundwater flux estimates in Table B-4.

We ask for the calculations for the above be presented in a manner that enables verification.